

SOLAR WIND KRYPTON IN GENESIS COLLECTORS AND IN LUNAR REGOLITH: WHY ARE THEY DIFFERENT? A. Meshik¹, C. Hohenberg¹, O. Pravdivtseva¹, and D. Burnett². Washington University, Saint Louis (am@physics.wustl.edu), ²California Institute of Technology.

Compared to Xe, Kr demonstrates the smallest isotopic variations among solar system components. At the same time Kr is more sensitive to terrestrial contamination since atmospheric $^{84}\text{Kr}/^{132}\text{Xe} = 27.7$ is the highest among all known solar and pre-solar components. Therefore higher precision isotopic analyses, and careful control of contamination, are needed to make accurate determinations of Kr isotopic compositions of various solar system components.

Within experimental uncertainties Solar Wind (SW) Xe collected by Genesis mission for 27 months [1] agree with SW-Xe accumulated by lunar regolith [2]. However “lunar” Kr [2] seems to be isotopically heavier than Genesis Kr by 1.6 ‰/amu. There are three potential reasons why mass fractionation may affect Kr more than Xe.

Kr can be potentially fractionated prior to analysis when heavy noble gases (Kr and Xe) are cryogenically separated from Ar to avoid pressure dependence and “change-of-charge” effects on ^{80}Kr . However, the new variable temperature design of the charcoal finger used in the measurements of the Genesis SW results in a nearly clean separation of Ar from Kr. Charcoal (from the Reynolds lab), kept at -125°C for 40 minutes, absorbs > 98.5% of the Kr and only 2% of the Ar. Under these conditions we do not expect any isotopic fractionation of the Kr and, since both the SW sample and the standard were run using the same protocol, any residual fractionation would be calibrated out.

The second possibility is related to the collection by Genesis itself. If Kr were collected with less than 100% efficiency and/or not completely retained, it would also be isotopically fractionated. That was indeed the case for SW-He implanted into Al-collectors, but Ne and Ar, were not fractionated so those same collectors should have captured SW-Kr without fractionation.

Therefore, those differences suggest that it is the light isotopes of lunar Kr that must have been preferentially lost. Indeed, $^{84}\text{Kr}/^{132}\text{Xe}$ in lunar soils varies from 4.7 to 9.0 [3], while in the Genesis collectors it is 9.55 ± 0.16 [4]. Most probably lunar grains experienced diffusional Kr losses favoring more the mobile light isotopes. This effect will also be enhanced by the depth-dependent fractionation of constant velocity implantation, coupled with surface erosion. Lunar surfaces quickly saturate under SW bombardment. H, if retained, would exceed the lattice atoms after 1,000 years, enhancing surface sloughing. Deeper (heavier) isotopes will be enriched as the surface erodes. If correct, it is problematic that accurate isotopic compositions of He, Ne and Ar can result from analyses of the lunar regolith so the Genesis data may be the only reliable source providing this information.

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References: [1] Meshik A. P., et al. 2012. Measuring the isotopic composition of solar wind noble gases. In: *Exploring the Solar Wind* (ed. M. Lazar). InTech, 93–120. [2] Pepin R. O. et al. 1995 *Geochimica et Cosmochimica Acta* 59, 4991–5022. [3] Wieler R. 2002. Noble Gases in the Solar System. In: *Reviews in Mineralogy & Geochemistry*, v.47, 21–70. [4] Meshik A. et al. 2009. *40th Lunar and Planetary Science Conference*, Abs.#2037.